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Genetic Selection for Body Weight in Japanese Quail (*Coturnix coturnix japonica*) Under Different Nutritional Environments

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Abstract | Japanese quail is an interested bird due to its early sexual maturity, high egg production and low requirements of housing space and feeding cost. Genetic selection was conducted for high four week body weight in Japanese quails using two different nutritional environments to determine the effect of nutritional environment on selection response of body. Japanese quails were selected under standard crude protein level diet (24.15 % CP) referred as SHW line, and under a low protein diet (18.07 % CP) referred as LHW line, and kept a control line for each nutritional environment as SCL and LCL respectively. The results showed that selection response for body weight of females in low protein diet (27.73 g.) was higher than males and females in selected line in standard protein diet (20.77 and 20.70 g. respectively). In general there were significant heavier body weight of birds in standard crude protein diet compared with low crude protein diet in each of base population, selected parents and progeny in first generation. There were significant differences between SHW and LCL in body weight and weight gain at six weeks of age, while there were significant differences between LHW and both SCL and LCL in feed intake and feed conversion at six weeks of age.

Keywords | Quails, Protein levels, Genetic selection, Growth performance.

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INTRODUCTION

Japanese quail used in poultry industry for its meat and egg production due to many features such as low feed intake, low rearing area requirements, low breeding cost and high disease resistance (Narinc et al., 2010). Based on these advantages, the reared number of quails is gradually increasing in the world poultry industry as a valuable source for eggs and meat production. Commercially, quails are produced mainly for meat production in Europe countries and for egg production in Japan and used as a dual-purpose birds in many Asian countries (Minvielle, 1998). The National Research Council recommendations of crude protein was 24 % for growing Japanese quails (NRC, 1994). Global environment suffering from pollution from ammonia emission and nitrogen excretion from poultry industry, beside that the protein being the most expensive diet component which affect the total cost of production, so the recent trends are decreasing the protein levels in poultry diets without significant effects on production performance. Wen et al. (2017) recorded that quails reared on diets with crude protein range 17.61-25.32 % had no significant influence on carcass yield at 42 days of age.

Most breeding programs that aimed to improve meat production are focused on increase live body weight and feed intake at fixed ages, and most studies carried out to increase the body weight in early periods using genetic selection which represent an important tool for genetic improvement in animal breeding program (Hassan, 2011; Fadhil and Hassan, 2018) or using outbreeding mating system between lines to get heterosis in the next generation (Hassan and Ali, 2017). Phenotypic selection used

widely for body weight improvement in poultry due to high heritability of body weight which refers to positive correlation between phenotype and the breeding value of the individual.

The study aimed to investigate the effect of low crude protein nutritional environment on the selection response for body weight at four weeks of age, growth performance and egg production.

MATERIALS AND METHODS

Study Site

This study was conducted in poultry house at the research farm in the Department of Animal production- College of Agriculture- University of Diyala, in the Province of Diyala, Iraq. Mean temperature during Autumn season (Sept. to Dec.) range between 15 to 38 °C. The annual rainfall ranges between 5 to 25 mm.

Birds and Management

Two base populations (200 one day old chicks for each population) were reared in wooden boxes designed for this purpose, using *ad libitum* two different nutritional environments and natural water. The same diet and quantities was introduce for males and females during the experimental period extended from Nov. 2, 2017 to Jun 14, 2018. The first diet represents standard diet 24.15 % crude protein for growing period and 20.21 % crude protein for egg production period, the second represents low protein diet 18.26 % crude protein for growing period and 18.07 % crude protein for egg production period.

Selection Procedure

The selection procedure for body weight at four week of age was performed for one generation to establish selected lines, 30 females and 15 males with higher body weight at four week of age were selected individually for high body weight line in standard diet (SHW), and in low protein diet (LHW), and control lines were reared under random breeding, and no selection being practiced among the control birds , for standard and low protein diet.

The hatching eggs were collected for each line during three days period, and transferred to the hatchery (Hassan and Abd – Alsattar, 2015), and the procedure was replicated for three hatches. The hatched chicks were raised until 14 weeks of age and the measurements were recorded for meat and egg production characteristics.

Statistical Analysis

Data were analyzed using the general linear model (GLM) procedure according to factorial experiment 2×3 conducted with completely randomized design. The statistical analysis performed by SPSS version 22 software. The multiple comparisons among the group means for significance were done by Tukey test at P≤0.05 significant level.

RESULTS

The response to selection for body weight at four week of age for both males and females in two nutritional environments are presented in Table 1. In low protein nutritional environment, the response to selection in female is higher than males (27.73 *vs.* 15.60 g. ; P≤0.05) in the same nutrition environment although the selection differential of males was higher than females (22.08 *vs.* 17.21 g. respectively; P≤0.05), and also these selection response is higher than females and males in standard nutritional environment (20.70 and 20.77 g. respectively).

Table 1: Selection differential, selection response and relative response for selected lines for body weight at four weeks of age in different nutritional environments.

Groups	Gender	Selection differential (g.)	Selection response (g.)	Relative response (%)
High body weight in standard nutrition	Male	24.86	20.77	14.30
	Female	20.83	20.70	13.75
	Over all	22.84	20.39	13.81
High body weight in low nutrition	Male	22.08	15.60	11.59
	Female	17.21	27.73	19.45
	Over all	20.01	21.65	15.62

The means of body weight at four week of age in two nutritional environments are presented in Table 2. The results showed significant heavier body weight of birds in standard crude protein level compared with low crude protein level in base population, selected parents and progeny.

Table 2: Means± S.E. of body weight (gram) at four weeks of age for base population, selected parents and their progeny in different nutritional environments.

Crude protein level	Base population	Parents	Progeny
Standard crude protein	127.32 ± 0.85 a	149.95 ± 1.53 a	147.94 ± 1.99 a
Low crude protein	117.09 ± 1.24 b	135.32 ± 1.17 b	138.61 ± 2.13 b

Different letters refer to significant differences (P≤0.05) between means by Tukey test

The live body weight of males, females and unsexed birds at four weeks of age are shown in Table 3. It appears from the table that there are no significant differences between males and females in the base population, parents and their progeny in both two nutritional environments.

There are significant interaction (P≤0.05) between sex and protein level in the diet presented in Table 4. The results appeared significant heavier body weight of female in standard protein level environment compared with both male and female in low protein level environment in the base population and selected parents, but there are no significant differences between females in low protein level environment and both males and females in standard protein level environment.

Table 3: Effect of gender in body weight (gram) at four weeks of age for base population, selected parents and their Progeny.

Gender	Base population	Parents	Progeny
Males	122.50 ± 1.36	146.36 ± 1.53	139.97 ± 3.95
Females	125.25 ± 1.54	142.96 ± 1.86	146.58 ± 3.38
Over all	123.92 ± 1.03	144.09 ± 0.95	143.27 ± 2.72

Table 4: Body weight (gram) at four weeks of age for selected parents and their progeny of males, females in different nutritional environments(Means ±S.E.)

Nutritional Environments	Gender	Base population	Parents	Progeny
Standard crude protein	Male	124.52 ± 1.77 ab	149.38 ± 1.64 ab	145.29 ± 6.07 ab
	Female	129.89 ± 1.63 a	150.23 ± 1.89 a	150.59 ± 2.10 a
	Overall	127.21 ± 1.70 a	150.05 ± 1.77 ab	147.60 ± 4.52 ab
Low crude protein	Male	119.04 ± 2.06 bc	141.84 ± 2.38 bc	134.64 ± 0.06 b
	Female	114.84 ± 2.93 c	132.05 ± 1.84 d	142.57 ± 5.66 ab
	Overall	117.09 ± 1.76 bc	136.95 ± 2.11 cd	138.59 ± 2.89 ab

Table 5: Body weight, weight gain, feed intake and feed conversion in different selected lines at six weeks of age (Means ±S.E.).

Groups	Body weight (g.)	Weight gain (g.)	Feed intake (g.)	Feed conversion
Control in standard nutrition	181.90 ab ± 0.41	173.66ab ± 0.57	707.50b ± 44.75	4.07b ± 0.25
Selection in standard nutrition	200.02 a ± 8.07	191.59 a ± 7.60	808.24 ab ± 47.54	4.21 b ± 0.13
Control in low protein nutrition	177.10 b ± 6.93	168.66 b ± 6.72	775.83 b ± 38.18	4.60ab ± 0.15
Selection in low protein nutrition	193.56 ab ± 4.65	185.19ab ± 4.45	965.49 a ± 98.44	5.22 a ± 0.53

Different letters refer to significant differences (P≤0.05) between means by Tukey test.

There are significant differences between SHW and LCL in body weight and weight gain at six weeks of age (Table 5), while there are significant differences between LHW and both SCL and LCL in feed intake at the same age. The feed conversion in LHW (5.22) appeared significant decreased compared with both SCL and SHW lines (4.07 and 4.21 respectively; P≤0.05).

Table 6 showed significant superiority of LHW in egg production percentage compared with SCL, but there are no significant differences among LHW and SCL compared with both SHW and LCL in the same trait.

Table 6: Egg production, count of eggs per hen in different lines (Means ±S.E.).

Groups	Egg production (%)	Count of eggs/ hen/week
Control in standard nutrition	67.02 ± 4.63 b	4.69 ± 0.32
Selection in standard nutrition	70.18 ± 5.36 ab	4.91 ± 0.38
Control in low protein nutrition	72.38 ± 6.12 ab	5.07 ± 0.43
Selection in low protein nutrition	77.43 ± 5.62 a	5.42 ± 0.39

Different letters refer to significant differences (P≤0.05) between means by Tukey test.

DISCUSSION

The values of selection response in body weight at four weeks of age which presented in Table 1 reflect the important role of the additive gene action that affect the body weight in Japanese quail and as a result the phenotypic selection in the current study caused an improvement in meat production of quails. The results recorded significant differences between males and females in different nutritional environments, this situation agreed with Taşkin et al. (2016) who found significant differences between females and males in body weight across selection generations. Numerous studies reported reduction in the male body weight appeared at the beginning of puberty compared with females may be result due to competition among males for social hierarchy which cause reduction in their body weight because of the excess of fighting activity and reduction of time of feeding, this situation appear obviously in low protein level diet, and that may explain the superiority of body weight of birds in standard crude protein level compared with low crude protein level, the results agreement with Rajini and Narahari (1998) who recorded higher body weight with diets containing levels of 26 to 28% crude protein.

The genetic groups appeared significant differences in feed

conversion, and the results not agreed with Dowarah and Sethi (2014) who recorded no significant differences in feed conversion among diets with different crude protein levels.

The significant superiority of selected line in low crude protein diet in respect egg production percentage compared with SCL, not agree with numerous authors recorded negative correlation between body weight and egg production, such as Trn et al. (2003) who reported no significant effect of crude protein levels with range 16 – 26 % on egg production up to 63 days of age due to high body weight. Also the results disagree with Anthony et al. (1996) who reported that selection for 4-wk body weight had a negative effect on fitness traits, including egg production.

CONCLUSION

The results of the current study indicate that selection for high body weight in low crude protein diet result increase in the egg production percentage compared with the control line in standard diet, while the decrease in crude protein caused significant decline in body weight at four weeks of age. The crude protein level in the diet depends on the purpose of production (egg or meat production).

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CONFLICT OF INTEREST

There is no conflict of interest.

AUTHORS CONTRIBUTION

Khalid Hamid Hassan: Developed the concepts and designed the experiments, and Drafting manuscript.
Mona A. Fadhil: Performed the practical part of the study in the poultry house, and recording data.

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